as high as possible.

For this reason, in case of the color image reading, the allowable forward current is often maintained close to 45 mA.

On the other hand, in the drive timing of the present embodiment shown in Fig. 8, the turn-on duty ratio of the LEDs of R, G and B colors is about 33%, as in the case of the color image reading, so that, even if the LEDs are driven with the allowable limit of 45 mA in the color image reading, the forward current of the LEDs need not be changed in the black-and-white image reading and they can be driven under the same conditions.

Fig. 11 is a flow chart of the light source control in the present embodiment. At first, a step S1 discriminates the entry of the reading mode, and, if it is the black-and-white image reading mode, the sequence proceeds to a step S2. In case of reading the image of a first line, a step S3 turns on the R LED for a period t_{ron1} by a signal ΦR. At the same time the sensor array is activated by a start pulse SP and a clock pulse CLK. Then the sequence proceeds to steps S4 and S5 for respectively turning on the G LED and B LED for periods t_{gon2} and t_{bon3} by signals ΦG and ΦB. During these periods, W signals corresponding to the black-and-white image are accumulated in the pixels of the sensor array. After the image reading of a line, the image

sensor unit 200 moves to a next reading line and the start pulse SP is entered again, whereupon, in a step S6, the W signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then externally output one pixel by one pixel in succession.

The pixels of the sensor array store the W signals of the next reading line. After the image reading of this reading line, the image sensor unit 200 is moved to a further next reading line while the start pulse SP is entered again, whereby the W signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then externally output one pixel by one pixel in succession. The black-and-white image reading of the entire original image can be achieved by repeating the above-explained sequence, while moving the image sensor unit 200 line by line in the sub scanning direction.

In case the step S1 identifies the color image reading mode, the light source is controlled in a similar manner as shown in Fig. 36. At first the sequence proceeds to a step S8 to discriminate whether the image reading is for the first line, and, if so, the sequence proceeds to a step S9 to turn on the R LED only by the signal ΦR. Then sensor array is activated by the start pulse SP and the clock pulse CLK to

accumulate the R signals in the pixels of the sensor array. After the lapse of the R signal accumulation time t_{ron12}, the R LED is turned off by the signal ΦR. Then in a step S10, the G LED is turned on by the signal ΦG and the start pulse SP is entered again, whereby the R signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then externally output one pixel by one pixel in succession.

In this state the G signals are at the same time accumulated in the pixels of the sensor array. After the lapse of the G signal accumulation time t_{gon12}, the G LED is turned off by the signal ΦG. Then in a step S11, the B LED is turned on by the signal ΦB and the start pulse SP is entered again, whereby the G signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then externally output one pixel by one pixel in succession.

In this state the B signals are at the same time accumulated in the pixels of the sensor array. After the lapse of the B signal accumulation time t_{bon12}, the B LED is turned off by the signal ΦB. In case a step S12 identifies that a next line is to be read, a step S13 turns on the R LED by the signal ΦR and the start pulse SP is entered again, whereby the B signals already accumulated in the pixels of the sensor array are

simultaneously transferred to the analog memories of the sensor array and are then externally output one pixel by one pixel in succession.

In this state the image sensor unit 200 has already been moved to a next reading line, and the operations are executed in a similar manner to obtain the R, G and B signals. The color image reading of the entire original image can be achieved by repeating the above-explained sequence, while moving the image sensor unit 200 line by line in the sub scanning direction.

In the present embodiment, the turn-on period of the R LED is selected as $t_{ron1} = t_{ron12}/3$, while that of the G LED is selected as $t_{gon1} = t_{ron12}/3$, and that of the B LED is selected as $t_{bon1} = t_{bon12}/3$, and the LEDs are so adjusted that the line sensor provides the output of a predetermined level when a white standard board is illuminated in the period t_{ron12} by the R LED only, then in the period t_{gon12} by the G LED only and in the period t_{bon12} by the B LED only. Therefore the output of a same level can be obtained from the line sensor also when the white standard board is illuminated by the R, G and B LEDs respectively for the periods t_{ron1}, t_{gon1} and t_{bon1}.

Consequently, the turn-on control of the R, G and B LEDs as shown in Fig. 8 allows to read a line of the black-and-white original image within a reading time same as that per color per line in the color image reading. Thus, as the start pulses SP and the clock

signals CLK can be same as those in the color image reading mode, the output signal Vout of the image sensor can be output in the same timing as in the color image reading, and the signal processing circuit can also be same.

Also, the turn-on control pulses ΦR, ΦG, ΦB for the LEDs can be generated easily because the turn-on and turn-off timings for the R, G and B LEDs in Fig. 8 are same as those in the color image reading mode, except that the turn-on period of each LED is reduced to 1/3 without the change in the turn-on duty ratio in each of the R, G and B LEDs. Also in contrast to the conventional black-and-white image reading mode shown in Fig. 37, the R, G and B LEDs are not turned on at the same time, so that the LED substrates 41, 42 show smaller increase in temperature, thus improving the reliability.

In the above-explained driving method of the present embodiment in the light source-switched color image sensor utilizing the R, G and B LEDs, there is always obtained the advantage that the forward current need not be changed between the color reading mode and the black-and-white reading mode, regardless of the relationship between the allowable forward current of the LED and the duty ratio thereof shown in Fig. 9. Also the signal processing can be same in both modes, because the reading time for the black-and-white image

is exactly 1/3 of that for the color image so that the output signals can be obtained at the same timing for the black-and-white image and for the color image.

As explained in the foregoing, the driving conditions of the present embodiment for the color image sensor unit enable easy reading of the black-and-white image, with the LED drive circuit, the sensor array drive circuit and the signal processing circuit same as those for the color image reading mode.

Fig. 12 shows a timing chart of a second embodiment of the present invention, showing the turn-on timings of the R, G and B LEDs and the output timings of the image sensor in case of the black-and-white image reading as in Fig. 8.

Fig. 13 is a flow chart for the light source control in the present embodiment. At first, when the image reading mode is entered in a step S1, the sequence proceeds to a step S2 in case of the black-and-white image reading mode, and, in case of reading the image of a first line, the sequence proceeds to a step S21 to simultaneously turn on the R, G and B LEDs respectively for periods t_{ron1}, t_{gon2} and t_{bon3} by the signals ΦR, ΦG and ΦB. Also the sensor array is activated by the start pulse SP and the clock pulse CLK, whereby W signals corresponding to the black-and-white image are accumulated in the pixels of the sensor array. After the image reading of a line,

the image sensor unit 200 is moved to a next line and the start pulse SP is entered again, whereby, in a step S6, the W signals accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are transferred to the exterior one pixel by one pixel in succession.

The function in case the step S1 identifies the color reading mode is same as already explained in relation to Fig. 11 and will not, therefore, be explained further. The relationship between t_{ron1}, t_{gon1}, t_{bon1} and t_{ron12}, t_{gon12}, t_{bon12} is same as that in the first embodiment.

In the present embodiment, all the R, G and B LEDs are simultaneously turned on in the reading time of the black-and-white image of a line and the black-and-white image is reproduced from the output signals of the plural line sensors. The black-and-white image reading of a line is completed within a time same as the turn-on period of the R, G or B LED in the color image reading mode shown in Fig. 36. Consequently the start pulses SP and the clock pulses CLK can be same as those in the color image reading, and the signal processing circuit can be same since the output signals Vout of the image sensor can be obtained in the same timings as those in the color image reading.

Figs. 14 and 15 are respectively an external perspective view and a cross-sectional view of a light

source-switched color image sensor in a third embodiment of the present invention, wherein the configuration of the principal parts is same as that in the color image sensor 200 shown in Figs. 1 and 2, except that the frame 20 is replaced by a frame 70, the transparent glass plate 21 is replaced by a transparent glass plate 71, the base plate 25 is replaced by a base plate 75, and the light-guiding light source 3 is replaced by a light-guiding light source 53.

Figs. 16 and 17 respectively show the longitudinal shape and the cross section of the light-guiding light source 53, wherein LED substrates 43, 44 are mounted on entrance faces 54 at both ends. There are also shown a light guiding portion 55 for guiding the light emitted from the LED chips 31 to 33 in the longitudinal direction of the light-guiding light source 53, a reflecting portion 56 for diffusing and reflecting the light, guided in the light guiding portion 55, toward the original image, and a condensing portion 57 for condensing the light reflected from the reflecting portion 56 into a portion to be read of the original image. Broken-lined rectangles indicate the positions of the LED chips 31 to 33 on the LED substrate 43.

Fig. 18 shows the arrangement of the LED chips 31 to 33 of three kinds for R, G and B colors on the LED substrate 43, and two LEDs of each kind are directly

mounted on the LED substrate 43. As in the first embodiment, these LEDs can be independently turned on and off for each of the R, G and B colors.

Though not illustrated, the LED chips 31 to 33 of three kinds for R, G and B colors are directly mounted also on the LED substrate 44, in the same manner as on the substrate 43. The light emitted from the LED chips 31 to 33 on these LED substrates 43, 44 illuminates only the vicinity of the area to be read of the original, in the same principle as in the first embodiment, but, since the LED chips 31 to 33 are directly mounted on the LED substrates 43, 44, these substrates 43, 44 and the light-guiding light source 53 are made smaller than the LED substrates 41, 42 and the light-guiding light source 3 in the first embodiment. Also each entrance face of the light-guiding light source has a larger number of LED chips mounted thereon, thereby illuminating the original image with a higher illumination intensity and enabling the color image reading with a higher speed.

The LED chips employed for illuminating the original image in the color image sensor unit of the present embodiment are associated, because of the manufacturing process thereof, with a fluctuation in the light intensity of a distribution shown in Fig. 19, so that the illumination of the original image has to be made in consideration of the fluctuation in the

light intensity of about 3 times. For this reason, the turn-on period of each LED chip is regulated according to the light intensity thereof as shown in Fig. 20, so as to obtain a constant output level from the sensor when the standard white board is illuminated.

More specifically, in case of incorporating a darkest LED chip, with a relative light intensity of 0.5, in the image sensor unit, the predetermined output level is obtained from the sensor by turning on the LED chip for the entire reading time of a line, and, for a brighter LED chip, such predetermined output level is obtained by shortening the turn-on period of the LED in proportion to the light intensity in comparison with that of the darkest LED chip with the relative light intensity of 0.5.

As explained in the foregoing, the light source-switched color image sensor of the present embodiment is controlled, as in the first embodiment, by the image sensor drive circuit 101 shown in Fig. 35, and the control signals ΦR, ΦG, ΦB, SP, CLK as shown in Fig. 20 are supplied to the light source-switched image sensor unit 201 to execute the image reading operation in the following manner.

At first, prior to the actual image reading operation, the R, G and B LEDs are respectively turned on and the respective turn-on periods t_{ron19}, t_{gon19}, t_{bon19}, are so determined as to obtain a predetermined output

level from the sensor when the standard white board is illuminated.

Then the actual image reading operation is executed in the manner shown in Figs. 21 and 23, as in the first embodiment. In the color reading mode, in a step S31, the R LED alone is turned on, and is turned off after the period t_{ron19} determined in advance by the irradiation of the standard white board. At the same time the sensor array is activated by the start pulse SP and the clock pulse CLK, whereby the R signals are accumulated in the pixels of the sensor array. The signal accumulation times (signal read-out times) t_{r19}, t_{g19}, t_{b19} for the R, G and B colors are determined corresponding to the light intensity of the darkest LED chip, and the G LED chip is normally not turned on immediately after the R LED chip is turned off.

After the lapse of the predetermined R signal accumulation time, in a step S32, the G LED is turned on and the start pulse SP is entered again, whereby the R signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then output to the exterior in succession, pixel by pixel. At the same time, in this state, G signals are accumulated in the pixels of the sensor array.

The G LED is turned off after the period t_{gon19} determined in advance by the irradiation of the

standard white board. The G signal accumulation time is also determined corresponding to the light intensity of the darkest LED chip, so that the B LED chip is not turned on until the lapse of such predetermined time. In a step S33, after the lapse of the G signal accumulation time, the B LED is turned on and the start pulse SP is entered again, whereby the G signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then output to the exterior in succession, pixel by pixel. At the same time, in this state, B signals are accumulated in the pixels of the sensor array.

The B LED is turned off after the period t_{bon19} determined in advance by the irradiation of the standard white board. The B signal accumulation time is also determined corresponding to the light intensity of the darkest LED chip as in the case or R and G signal accumulation times, so that the R LED chip is not turned on until the lapse of such predetermined time. After the lapse of the B signal accumulation time, the image sensor unit 201 is moved to a next reading line, and, in a step S34, the R LED is turned on and the start pulse SP is entered again, whereby the B signals already accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then output

to the exterior in succession, pixel by pixel. At the same time, in this state, R signals are accumulated in the pixels of the sensor array.

The color image reading over the entire original image, based on the LED chips involving certain distribution in the light intensity, can thus be achieved by repeating the above-explained process while moving the image sensor unit 200 line by line in the sub scanning direction.

In the black-and-white image reading mode, the image sensor drive circuit 101 provides the light source-switched image sensor unit 201 with control signals ΦR, ΦG, ΦB, SP and CLK as shown in Fig. 18, thereby executing the image reading operation in the following manner.

At first, prior to the actual image reading operation, the R, G and B LEDs are respectively turned on and the respective turn-on periods t_{ron20}, t_{gon20}, t_{bon20} are so determined as to obtain, from the sensor upon irradiation of the standard white board, an output level which is equal to 1/3 of the predetermined output level in the color image reading mode. Then, as shown in Fig. 22, the R, G and B LEDs are turned on in succession for respective periods of t_{ron20}, t_{gon20}, t_{bon20} within the reading time for one color and for a line in case of the color image reading mode, thereby providing, from the line sensor, an output level same

as that in the color image reading mode. The above-mentioned determination of the turn-on periods of the R, G and B LEDs provides relationships $t_{ron20} = t_{ron19}/3$, $t_{gon20} = t_{gon19}/3$ and $t_{bon20} = t_{bon19}/3$, so that the ratio of the turn-on periods of each LED in the black-and-white reading mode and in the color reading mode becomes 1:3 as in the first embodiment.

After the determination of the turn-on periods of the R, G and B LEDs in this manner, the actual image reading operation is executed according to the timing chart shown in Fig. 22. The sensor array is activated by the start pulse SP and the clock pulse CLK, and, in steps S35, S36 and S37 shown in Fig. 23, the R, G and B LEDs are turned on in succession for respective periods t_{ron20}, t_{gon20}, t_{bon20} within the reading time of a line, whereby W signals corresponding to the black-and-white image are accumulated in the pixels of the sensor array. As in the foregoing embodiment, the W signal accumulation time t_{w20} is determined in advance in consideration of the case of color image reading with darkest R, G and B LED chips, so that $t_{w20} = t_{r19} = t_{g19} = t_{b19}$.

After the lapse of the above-mentioned predetermined period t_{w20}, the image sensor unit 201 is moved to a next reading line, and the start pulse SP is entered again whereby, in a step S6, the W signals of the preceding reading line already accumulated in the

pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then output to the exterior in succession, pixel by pixel. In this state, the R, G and B LEDs are turned on, as in the preceding reading line, in succession for respective periods of t_{ron20}, t_{gon20}, t_{bon20} within the reading time of a line whereby the W signals corresponding to such next reading line are accumulated in the pixels of the sensor array. The color image reading over the entire original image, based on the LED chips involving certain distribution in the light intensity, can thus be achieved by repeating the above-explained process while moving the image sensor unit 201 line by line in the sub scanning direction.

The above-explained driving method of the color image sensor with the timings shown in Fig. 22 allows to read the black-and-white original image within a reading time equal to 1/3 of that for the color image reading, even when the LED chips showing certain distribution in the light intensity are used with light intensity adjustment. This driving method allows to use same signal processing for the black-and-white reading mode and the color reading mode because the output signals can be obtained in the same timings in both modes. Consequently the black-and-white image reading can be easily achieved with the color image sensor unit combined with an LED drive circuit, a

sensor array drive circuit and a signal processing circuit.

Fig. 24 is a timing chart showing the function of a fourth embodiment of the present invention, showing the turn-on timings of the R, G and B LEDs and the output timing of the image sensor in the black-and-white image reading as in Fig. 12, and Fig. 25 is a flow chart showing the image reading operation of the present embodiment.

Also in the present embodiment, all the R, G and B LEDs are simultaneously turned on in the reading time of the black-and-white image of a line as in the second embodiment, and the black-and-white image is reproduced from the output signals of the plural line sensors.

At first, prior to the actual image reading operation, the R, G and B LEDs are respectively turned on in the same manner as in the color image reading mode, and the respective turn-on periods t_{ron20}, t_{gon20}, t_{bon20} are so determined as to obtain a predetermined output level from the sensor upon irradiation of the standard white board. Since three LEDs are simultaneously turned on in the black-and-white image reading mode, the sensor output level, obtained by irradiating the standard white board with each of the R, G and B LEDs is selected equal to 1/3 of the output level in the color image reading mode, so that there stand relationships $t_{ron20} = t_{ron19}/3$, $t_{gon20} = t_{gon19}/3$ and

$t_{bon20} = t_{bon19}/3$.

Then, in a step S41 in Fig. 25, all the LEDs of three kinds of R, G and B colors are turned on, and the sensor array is activated by the start pulse SP and the clock pulse CLK, whereby W signals corresponding to the black-and-white image are accumulated in the pixels of the sensor array. The R, G and B LEDs are respectively turned off, after the lapse of respective turn-on periods t_{ron20}, t_{gon20}, t_{bon20} determined by reading the standard white board as explained above. The W signal accumulation time t_{w20} is determined corresponding to the case of color image reading with the darkest LED chips, where $t_{w20} = t_{ron19} = t_{gon19} = t_{bon19}$.

None of the R, G and B LEDs is turned on until the lapse of the above-mentioned period t_{w20}. After the lapse of the W signal accumulation time t_{w20}, the image sensor unit 201 is moved to a next reading line, whereupon all the R, G and B LEDs are turned on. Also the start pulse SP is entered whereby, in a step S6, the W signals of the preceding reading line accumulated in the pixels of the sensor array are simultaneously transferred to the analog memories of the sensor array and are then output to the exterior in succession, pixel by pixel. In this state, at the same time, the W signals of the next reading line are accumulated in the pixels of the sensor array.

The color image reading over the entire original

image, based on the LED chips showing certain distribution in the light intensity, can be achieved by executing the above-explained process while moving the image sensor unit 201 line by line in the sub scanning direction. Also such control provides the advantages similar to those in the foregoing embodiments.

The image sensor of a fifth embodiment is composed, as shown in Fig. 26, of a sensor array in which a plurality of sensor ICs 301, each containing an array of photoelectric converting elements, are linearly arranged according to the size of the original image to be read, on a sensor substrate 302 consisting for example of glass fiber-reinforced epoxy resin, a lens array 303, an illuminating device 304, a cover glass 305 consisting of a translucent member for supporting the original image, and a frame member 306 consisting of a metal such as aluminum or a resinous material such as polycarbonate resin, for supporting and positioning the above-mentioned components.

The illuminating device 304 illuminates, from a diagonal direction, the color original supported by the cover glass 305 with lights of R, G and B colors in switched manner, whereby the optical information of the original image in three R, G and B colors are focused by the lens array 303 onto the sensor ICs 301 and converted therein into electrical signals which are then processed in the system to reproduce the original

color image.

In case such color image sensor is used for reading a black-and-white image instead of the color image, there is required a long reading time since the image still has to be handled by the three-color signals of R, G and B, and there may also be generated errors resulting from errors in image reading. Particularly in case of reading a black-and-white original which is present between color originals, the operation becomes wasted because such black-and-white original is read also as a color original.

In the present embodiment, therefore, in case of reading a black-and-white image instead of the color image, the image reading speed is not altered but the luminances of the R, G and B colors for each reading line are adjusted by the control of the power supplies to the light sources, thereby preventing deterioration of the light sources in the luminances thereof. Figs. 27 and 28 are timing charts of the present embodiment, respectively in the color reading mode and in the monochromatic reading mode.

More specifically, as shown in Fig. 26, the power supply for the light source of R, G and B colors is provided with luminance-limiting variable resisters 310, 311, 312, and the illuminating light sources are switched in succession by a switch 315. In case of reading the black-and-white image present between the

color images, these variable resistors are shifted to higher resistances to limit the luminances of the light sources, thereby preventing the lowering in the illumination intensities resulting from the deterioration of the light sources and thus extending the service life of the image sensor. It is also rendered possible to improve the quality and reliability of the entire device, without requiring a change in the balance of the colors of the illuminating device in the change-over from the black-and-white original to the color original.

Fig. 29 is a flow chart showing the light source control operation of the present embodiment. In case a step S51 identifies the black-and-white reading mode, the sequence proceeds to a step S52 to increase the resistances of the variable resistors 310, 311, 312 thereby limiting the electric powers supplied to the LEDs. The resistances of the variable resistors may be independently selected, and it is not essential to increase the resistances of all the variable resistors. Then a step S53 executes the black-and-white image reading operation, and the sequence is terminated.

In case the step S51 identifies the color reading mode, a step S54 executes the color image reading operation, and the sequence is terminated.

Now there will be explained a sixth embodiment of the present invention, with reference to Figs. 30, 31

and 32. The timing chart in the color reading mode is same as that shown in Fig. 27.

In the present embodiment, in case of reading a black-and-white original with the color image sensor, the image reading is executed with a speed higher than in the color image reading to reduce the illuminating time of the R, G and B color for each image reading line, thereby preventing the lowering in luminance resulting from the deterioration of the light sources.

Referring to Fig. 30, a roller 320 for transporting the original is rotated at a speed which is three times of that at the color image reading mode, and the driving frequency of the sensor is also tripled. In case of reading the black-and-white original present between the color originals, the original image is illuminated by switching the light source of R, G and B colors in succession, and the electrical signals obtained by the sensor ICs are processed for the black-and-white image reading, whereby the turn-on period of the light sources is reduced for example to 1/3 of that in the color image reading mode, thereby preventing the lowering in the illumination intensity resulting from the deterioration of the light sources and extending the service life of the image sensor. It is also rendered possible to improve the quality and the reliability of the entire device, without requiring a change in the color balance

of the illuminating device between the black-and-white image reading and the color image reading. Fig. 31 is a timing chart of the present embodiment.

Fig. 32 is a flow chart showing the function of the present embodiment. In case a step S61 identifies the black-and-white reading mode, the sequence proceeds to a step S62 to triple the transport speed of the original and the driving frequency of the sensor and to reduce the turn-on period of each light source to 1/3. Then a step S63 executes the black-and-white image reading operation and the sequence is terminated. On the other hand, if the color image reading mode is identified, a step S64 executes the color image reading operation.

Now there will be explained a seventh embodiment of the present invention, with reference to Figs. 33 and 34.

In the present embodiment, in case of reading a black-and-white original with the color image sensor, the speed of the original transporting roller 320 is tripled in comparison with the case of color image reading, but the driving frequency of the sensor is not changed. For each reading line, all the R, G and B light sources are not turned on but the original image is illuminated with the light source of one or two colors. In this manner the total turn-on time of each light source is reduced to prevent the deterioration in

the luminance of the light sources.

Also the turned-on light source or sources are switched in succession for every reading line to prevent the difference in the deterioration of the luminance of the light sources of three colors.

Fig. 33 shows an example of switching the R, G and B light sources in succession for every reading line and effecting the correction on the photoelectrically converted signal obtained from every reading line. In case of reading the black-and-white original present between the color originals, the control is switched in this manner to prevent the lowering in the illumination intensity resulting from the deterioration of the light sources and to extend the service life of the image sensor. It is also rendered possible to improve the quality and the reliability of the entire device, without requiring a change in the color balance of the illuminating device at the shift from the black-and-white image to the color image.

Fig. 34 is a flow chart showing the function of the present embodiment. In case a step S71 identifies the black-and-white reading mode, the sequence proceeds to a step S72. In case of reading the first line, a step S73 turns on the R LED and a next step S74 executes the image reading. In case a step S75 identifies the reading of a next line, a step S76 turns on the G LED and a step S77 executes the image reading.

In case a step S78 identifies the reading of a further next line, a step S79 turns on the B LED and a step S80 executes the image reading. In the present embodiment, the turned-on light source is switched in succession for every reading line, in the order of R, G and B, but the switching order is not limited to the example mentioned above. It is also possible to turn on two light sources for every reading line and to switch the combination of the light sources for every reading line.

In case of reading the black-and-white original with the light source-switched color image sensor, the foregoing first to fourth embodiments maintain the same turn-on duty ratio of the light-emitting elements as in the color original reading operation, and turn on the light emitting elements at the same time or in succession while reducing the turn-on time of each light emitting element to 1/3, so that the forward current of each light emitting element can be maintained same both in the color image reading and in the black-and-white image reading and the forward current adjusting means for responding to the different reading modes can be dispensed with.

Also the signal accumulation time or the sensor output time for a line in the black-and-white image reading can be made same as that in the color image reading, so that the signal processing circuit need not

be added or provided with adjusting means for the black-and-white image reading. Also the number of component parts of the entire device can be significantly reduced by constituting the illuminating device with such light sources such as three LEDs of R, G and B colors and employing such illuminating device as the light source for the light source-switched color image sensor.

Also in such light source-switched color image sensor, in case of switching from the color image reading to the black-and-white image reading, the fifth to seventh embodiments turn on the light sources, such as LEDs of R, G and B colors, with reduced luminances, or effect the image reading at a higher speed while maintaining the light sources at luminances same as those at the color image reading, or turn on such light sources in time-shared basis for each reading line, in order to reduce the turn-on time of the light sources at the black-and-white image reading, thereby preventing the lowering in the illumination intensity resulting from the deterioration of the light sources and extending the service life of the image sensor. Also the quality and the reliability of the entire device can be improved since the balance of the colors of the illuminating device need not be varied at the shift from the black-and-white image reading to the color image reading.

Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.